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955 L'Enfant Plaza North, S.W.
Washington, D. C. 20024

date: November 3, 1971

to: Distribution

from: K. P. Klaasen

B71 11010

subject: Overhead Time Required at Science Stops on a Lunar Surface Traverse -- Case 310

ABSTRACT

The overhead time required at science stops on the Apollo 15 lunar surface traverses has been estimated, and updated estimates have been made for Apollo 16. A minimum of about 1 min 15 sec of overhead upon arrival and 1 min 25 sec of overhead upon departure are required at any science stop. These minimum times may increase if TV use and/or dusting of the TV, LCRU and LRV battery covers are required at every stop, including very short stops that might be used to obtain a quick rock and soil sample. Knowledge of these overhead times is useful in determining whether or not scheduling very short stops is a practical and efficient use of traverse time.

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MEMORANDUM FOR FILE

Introduction

At any science stop on a lunar surface geology traverse, a certain amount of time is required to perform tasks not directly involved in geologic investigation. These overhead tasks (such as those involving the LRV or the TV) took an average of about 7 min at each stop on Apollo 15. The traverse planners for Apollo 16 are currently considering including several very short stops scattered throughout the Descartes area in order to obtain samples over a wide range of terrain. These short stops will also include some overhead time. An evaluation of the amount of time required for overhead tasks at a short science stop will help to determine the minimum duration of such a stop and also whether or not this type of stop is a practical and efficient use of traverse time. Estimates of the time actually required for each overhead task on Apollo 15 were made using information in the voice transcripts of the mission. Then updates were made for Apollo 16 incorporating the effects of the changes made to date in procedures or hardware.

Overhead Tasks on Arrival at a Stop

1. Powering down the LRV - On Apollo 15, LRV power-down was performed by shutting off power to all systems other than the navigation system. This procedure took about 20 sec. For Apollo 16, MSFC has agreed that power-down can be accomplished using only the ±15 volt switch to the hand controller. This procedure should require only about 5 sec. At a short science stop, power-down could be avoided entirely if the LMP alone dismounted the LRV and performed the sampling activities by himself.

2. Reading out the LRV system displays - Reading the values for heading, bearing, distance, range, amp-hr, and temperature takes about 10 sec. These readouts should be done even at a short stop because the distance and range are used to help determine the sampling location.

3. Reading the sun-shadow device (SSD), pitch, and roll - These tasks took about 30 sec when performed on Apollo 15 and should be the same on Apollo 16. These readings are only required when a realignment of the navigation system gyro is needed. Thus, they should be read only at long stops.

4. Dismounting from the LRV - Dismounting required about 30 sec on Apollo 15 and should require the same time on Apollo 16. Simulations in both 1g and 1/6g have shown sampling from the LRV seat to be impractical. Therefore, dismounting will be necessary even at short stops.

5. Turning on the TV and aligning the high-gain antenna - TV operations averaged about 1 min 10 sec upon arrival at Apollo 15 stops where the TV was used. Fairly large variations in the time required were experienced at the various stops with over 3 min being required in one instance. Difficulty was experienced on Apollo 15 in aligning the high-gain antenna due to problems in finding the earth using the optical sight. For Apollo 16, the optical sight has been improved, and a more favorable earth/sun geometry will prevail. Thus, a reasonable estimate for TV-activation operations might be 30 sec. The Apollo Program Director has indicated a requirement that TV be used at every science stop; however, this requirement should probably be relaxed at stops shorter than about 5 min.

6. Dusting the TV, LCRU, and LRV battery covers - When dusting was done on Apollo 15, it took about 30 sec and should take about the same time on Apollo 16. On Apollo 16, a requirement that the crew perform dusting at every stop has been suggested. This requirement should not be made to apply at very short stops, however, since minimizing overhead at such stops is desirable and dusting at longer stops only should provide sufficient thermal control.

7. Equipment assembly - The time required to gather together the equipment needed for the planned activities at a stop varied considerably on Apollo 15. Equipment assembly time also proved hard to establish accurately from the voice transcripts. However, the time seemed to average out to about 1 min 30 sec per stop, with less time being required at shorter stops where less equipment was used, and more time being required at longer, more complex stops. Some time was also

spent troubleshooting camera problems. For Apollo 16, equipment assembly time can be assumed to be about 30 sec for a minimum of equipment (as might be required for a short stop). An additional 30 sec might be required for further equipment assembly at a longer stop. The actual time required at any stop should be estimated based on what specific items are to be used at that stop.

Overhead Tasks on Departure from a Stop

1. Equipment stowage - Time required to stow equipment depends again on what equipment is used at a given stop. About 40 sec was required as an average on Apollo 15. For Apollo 16, about 20 sec should be allotted for a minimum of equipment and an additional 20 sec for further equipment.

2. Turning off the TV and stowing the high-gain antenna - Deactivation of the TV took about 20 sec on Apollo 15 and should take the same time on Apollo 16 at stops where it is used.

3. Mounting the LRV - Mounting the LRV took an average of about 2 min 10 sec on Apollo 15. The time required was higher than expected because of difficulties with fastening the seatbelts. The seatbelts are being redesigned for the Apollo 16 LRV, and hopefully these difficulties will not be present. The mounting time should then be about 1 min, and mounting will have to be performed at every stop.

4. Powering up the LRV - Powering up the LRV took about 20 sec on Apollo 15 but should take only about 5 sec on Apollo 16 using the ±15 volt switch only. Power-up will be required at any stop where both crewmen dismount the LRV.

5. Realigning the navigation system gyro - A gyro realignment took about 40 sec on Apollo 15. The time requirement on Apollo 16 should be the same. A realignment should be necessary only at some long stops.

Summary

The overhead task times discussed above are summarized in the attached table. At any stop, a minimum of 1 min 15 sec of overhead upon arrival and 1 min 25 sec of overhead upon departure are clearly required. These minimum times may increase if TV use and/or dusting are truly required at every stop, including very short, rock- and soil-sample stops. If TV use and/or dusting are required at any short stop, the overhead time

may be so great that such a stop is no longer desirable. If the short stops are desirable even with the TV and/or dusting requirements, these requirements at a short stop should be reevaluated on their own merits.

K.P. Klaasen

2013-KPK-jab

K. P. Klaasen

Attachment

OVERHEAD TASK	REQUIREMENT	ESTIMATED TIME ON APOLLO 15 MIN/SEC	PREDICTED TIME FOR APOLLO 16 MIN/SEC	COMMENTS
DISMOUNT LRV	ALL STOPS	:30	:30	
LRV SYSTEM READOUT	ALL STOPS	:10	:10	
MINIMUM EQUIPMENT ASSEMBLY	ALL STOPS	:30	:30	
POWER DOWN LRV	STOPS WHERE BOTH CREWMEN DISMOUNT	:20	:05	USE ±15V SWITCH ON APOLLO 16
ALIGN HI-GAIN, TV ON	STOPS > 5 MIN	1:10	:30	IMPROVED SIGHTING OF HI-GAIN
DUST REFLECTORS, TV LENS	LONG STOPS ONLY	:30	:30	
FURTHER EQUIPMENT ASSEMBLY	STATION DEPENDENT	1:00	:30	CAMERA PROBLEMS ELIMINATED
READ SSD, PITCH, ROLL	LONG STOPS ONLY	:30	:30	

A) OVERHEAD ON ARRIVAL AT STOP

MINIMUM EQUIPMENT STOWAGE	ALL STOPS	:20	:20	
MOUNT LRV, FASTEN SEATBELT	ALL STOPS	2:10	1:00	IMPROVED SEATBELT DESIGN
POWER UP LRV	STOPS WHERE BOTH CREWMEN DISMOUNT	:20	:05	USE ±15V SWITCH ON APOLLO 16
TV OFF, STOW HI-GAIN	STOPS > 5 MIN	:20	:20	
FURTHER EQUIPMENT STOWAGE	STATION DEPENDENT	:20	:20	
REALIGN GYRO	LONG STOPS ONLY	:40	:40	

B) OVERHEAD ON DEPARTURE FROM STOP

TABLE 1 - OVERHEAD TIME REQUIRED AT SCIENCE STOPS

Subject: Overhead Time Required at Science Stops on a Lunar Surface Traverse -- Case 310

From: K. P. Klaasen

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